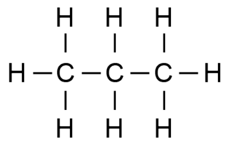
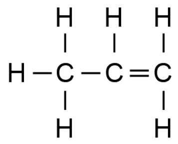
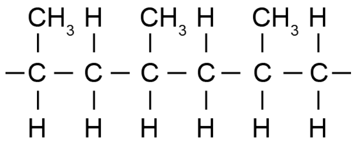
Assessment schedule – 2017

Chemistry: Demonstrate understanding of aspects of carbon chemistry (90932)

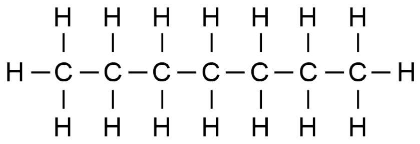
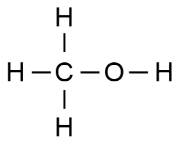
Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	 propane  propene	• TWO correct structures.		
(b)		• Correct structure, with THREE repeating units.		
(c)	The boiling point of propene is higher than ethene, as there is one more C atom in propene than in ethene, so propene has a higher molar mass. As the molar mass increases, the forces of attraction (intermolecular force) between the molecules increase, so more energy / heat is required to overcome these forces to form gaseous propene.	• Describes a valid reason for the higher boiling point of propene. E.g. larger molar mass / greater number of C atoms / longer chain / stronger or more forces.	• Links the greater number of carbons / higher molar mass to increased forces between molecules (intermolecular forces) and higher boiling point.	
(d)	Propene contains a carbon to carbon double bond whereas propane only contains carbon to carbon single bonds. Many small propene molecules are joined to form long-chain molecules. The (covalent) double bond between each carbon atom in the propene molecule is broken, and a single (covalent) bond formed between these carbon atoms and between carbon atoms of neighbouring molecules, forming a long carbon chain molecule (the polypropene molecule). (Suitable diagram may be used showing the breaking of C=C double bonds and the formation of C–C single bonds in the chain.)	• States that the small propene molecules are joining to form the long-chain polypropene molecule. • States that propene contains double bonds whereas propane only has (carbon to carbon) single bonds.	• Explains how propene molecules are linked to form polypropene molecules via the breaking of double bonds to form single bonds.	• Explains the polymerisation reaction, linking to **carbon-carbon double bonds** being broken and **carbon-carbon single bonds** being formed. AND explains that propane cannot undergo polymerisation as it only contains carbon to carbon single bonds. (Annotated diagrams may be used to illustrate an answer.)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	1a	2a	4a	5a	1m	2m	1e with (b) incorrect	1e + (b) correct

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	Crude oil consists of a mixture of hydrocarbon molecules of different sizes, which must be distilled to separate into useful fractions, since the fractions have different uses.	• Describes crude oil as a mixture of different hydrocarbons.	• Explains that the crude oil must be separated into its fractions (different hydrocarbons) to allow the fractions to be useful.	
(ii)	Hydrocarbons of different molecular masses have different boiling points. Smaller molecules have a smaller mass and therefore weaker intermolecular forces between molecules and hence lower boiling points. When the heated crude oil vapour enters the tower, the smaller hydrocarbons with the lower boiling points condense into liquids higher up in the tower where it is cooler, or remain as gases, and exit from the top of the tower.	• Recognises the separation of the (lighter and heavier) fractions depends on differences in the boiling points **OR** smaller hydrocarbons have a low boiling point **OR** top of the tower is cooler / bottom of tower is hotter.	• Links the small size of the hydrocarbon to its boiling point and where the fraction collects in the tower.	• Links the small size of the hydrocarbon to the size of the intermolecular forces, the boiling point and where the fraction is collected in the tower.
(b)	Decane → Pentane + Propene + Ethene $C_{10}H_{22} \rightarrow C_5H_{12} + C_3H_6 + C_2H_4$	• One product correct.	• All products correct.	
(c)	Cracking is a chemical reaction in which carbon to carbon bonds within the molecule are broken to form smaller hydrocarbons. This requires either high temperatures and pressures, or the use of a catalyst to break the carbon to carbon bonds. New products are formed, so this is a chemical process. Fractional distillation is a physical process where hydrocarbons are separated based on their physical properties (boiling points). No new substances are formed – the mixture is separated into different fractions based on mass / boiling point, therefore the process is physical. The two processes are different as cracking produces new products while fractional distillation is used to separate a mixture.	• States that cracking is chemical process and fractional distillation is a physical process. • Describes what cracking / fractional distillation is.	• Explains why one process is a chemical or physical process.	• Contrasts both processes; including reference to the physical / chemical properties of the hydrocarbons involved.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	2a	3a	4a	5a	3m	4m	1e	2e

Q	Evidence	Achievement	Merit	Excellence
THREE (a)(i)	 heptane  methanol	• BOTH structures correct.		
(ii)	Heptane is classified as a hydrocarbon, as it contains only C atoms and H atoms, whereas methanol contains an O atom.	• Describes why heptane is a hydrocarbon, OR why methanol is not.	• Explains why heptane is a hydrocarbon but methanol is not.	
(b)	Add sample of each separately to water. Methanol will dissolve – mix / form a single layer; since (small) alcohols are soluble in water because of the attractions between the alcohol and water, i.e. attraction between alcohol and water is greater than attraction between alcohol molecules. Heptane is insoluble and will not dissolve in water so we see two layers form. This is because the attraction between heptane and water is less than the attraction between heptane molecules (or there is no attraction between heptane and water).	• Describes how to distinguish both samples, including observations, for both substances.	• Links the test and observation to the physical properties **or** forces of attraction for both substances.	• Explains the physical properties that allow for identification of both substances.
(c)	$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$ $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$ or $CH_3OH + 1.5O_2 \rightarrow CO_2 + 2H_2O$ Complete combustion would burn with a blue / colourless flame while incomplete combustion burns with an orange flame and produces soot. The C (soot) and CO produced during incomplete combustion are harmful to humans. C (soot) can be inhaled and cause respiratory problems and damage the heart; it is also a carcinogen. CO is a poisonous gas as it binds to red blood cells (preventing oxygen binding) and may cause death. Advantages of using methanol Methanol produces less CO_2 so has less of an effect on the environment Methanol has only 1 carbon, so it is easy to ignite and will burn with an almost colourless flame.	• Describes observations for both complete and incomplete combustion. • States a valid effect on incomplete combustion of human health. • Gives one advantage of using methanol as a fuel.	• One correct, but incorrectly balanced equation. • Links incomplete combustion product to an impact on human health. • Links an advantage of burning methanol to a reason.	• ONE balanced symbol equation. • Compares the advantages of using methanol over heptane as a fuel.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	2a	3a	5a	6a	4m	5m	2e	3e

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24